What Is Claimed Is:

1   1.   A method for controlling rippling caused by optical proximity

2   correction during an optical lithography process used in manufacturing an

3   integrated circuit, comprising:

4   selecting an evaluation point for a given segment that is part of an edge in

5   a layout of the integrated circuit;

6   selecting at least one supplemental evaluation point for the given segment;

7   computing a deviation from a target location for the given segment at the

8   evaluation point;

9   computing a supplemental deviation for the given segment at the at least

10 one supplemental evaluation point;

11   adjusting a bias for the given segment, if necessary, based upon the

12 deviation at the evaluation point;

13   calculating a ripple for the given segment based upon the deviation at the

14 evaluation point and the supplemental deviation; and

15   if the ripple for the given segment exceeds a threshold value, performing a

16 ripple control operation.

1   2.   The method of claim 1, further comprising adjusting the bias again,

2   if necessary, and performing the ripple control operation, if necessary, for each

3   segment that is part of the layout of the integrated circuit.

1   3.   The method of claim 1, wherein prior to selecting the evaluation

2   point for the given segment, the method further comprises:

3   receiving a specification of the layout; and

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4   dissecting edges in the layout into segments for optical proximity

5   correction purposes.

1   4.   The method of claim 1, wherein performing the ripple control

2   operation involves performing a refinement operation that involves:

3   selecting additional dissection points for the edge that cause the given

4   segment to be divided into multiple segments;

5   selecting additional evaluation points for the multiple segments;

6   selecting additional supplemental evaluation points for the multiple

7   segments; and

8   adjusting the bias, if necessary, and performing the ripple control

9   operation, if necessary, for each of the multiple segments.

1   5.   The method of claim 4, wherein selecting additional evaluation

2   points involves using supplemental evaluation points as the additional evaluation

3   points.

1   6.   The method of claim 1, wherein performing the ripple control

2   operation involves performing a regeneration operation that involves:

3   changing the location of dissection points for the edge to cause the edge to

4   be divided into a different set of segments; and

5   adjusting the bias, if necessary, and performing the ripple control

6   operation, if necessary, for each segment in the different set of segments.

1   7.   The method of claim 6, wherein changing the location of the

2   dissection points involves swapping dissection points and evaluation points for

3   the edge.

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1   8.   The method of claim 1, wherein performing the ripple control

2   operation involves controlling the bias for the given segment so that the ripple for

3   the given segment does not exceed the threshold value, wherein as a consequence

4   of controlling the bias a critical dimension for the given segment may not meet

5   specification.

1   9.   The method of claim 1, wherein computing the deviation for the

2   given segment involves using a model-based technique for computing the

3   deviation.

1   10.   A computer-readable storage medium storing instructions that

2   when executed by a computer cause the computer to perform a method for

3   controlling rippling caused by optical proximity correction during an optical

4   lithography process used in manufacturing an integrated circuit, the method

5   comprising:

6   selecting an evaluation point for a given segment that is part of an edge in

7   a layout of the integrated circuit;

8   selecting at least one supplemental evaluation point for the given segment;

9   computing a deviation from a target location for the given segment at the

10   evaluation point;

11   computing a supplemental deviation for the given segment at the at least

12   one supplemental evaluation point;

13   adjusting a bias for the given segment, if necessary, based upon the

14   deviation at the evaluation point;

15   calculating a ripple for the given segment based upon the deviation at the

16   evaluation point and the supplemental deviation; and

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17   if the ripple for the given segment exceeds a threshold value, performing a

18   ripple control operation.

1   11.   The computer-readable storage medium of claim 10, wherein the

2   method further comprises adjusting the bias, if necessary, and performing the

3   ripple control operation, if necessary, for each segment that is part of the layout of

4   the integrated circuit.

1   12.   The computer-readable storage medium of claim 10, wherein prior

2   to selecting the evaluation point for the given segment, the method further

3   comprises:

4   receiving a specification of the layout; and

5   dissecting edges in the layout into segments for optical proximity

6   correction purposes.

1   13.   The computer-readable storage medium of claim 10, wherein

2   performing the ripple control operation involves performing a refinement

3   operation that involves:

4   selecting additional dissection points for the edge that cause the given

5   segment to be divided into multiple segments;

6   selecting additional evaluation points for the multiple segments;

7   selecting additional supplemental evaluation points for the multiple

8   segments; and

9   adjusting the bias, if necessary, and performing the ripple control

10   operation, if necessary, for each of the multiple segments.

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1   14.   The computer-readable storage medium of claim 13, wherein

2   selecting additional evaluation points involves using supplemental evaluation

3   points as the additional evaluation points.

1   15.   The computer-readable storage medium of claim 10, wherein

2   performing the ripple control operation involves performing a regeneration

3   operation that involves:

4   changing the location of dissection points for the edge to cause the edge to

5   be divided into a different set of segments; and

6   adjusting the bias, if necessary, and performing the ripple control

7   operation, if necessary, for each segment in the different set of segments.

1   16.   The computer-readable storage medium of claim 15, wherein

2   changing the location of the dissection points involves swapping dissection points

3   and evaluation points for the edge.

1   17.   The computer-readable storage medium of claim 10, wherein

2   performing the ripple control operation involves controlling the bias for the given

3   segment so that the ripple for the given segment does not exceed the threshold

4   value, wherein as a consequence of controlling the bias a critical dimension for

5   the given segment may not meet specification.

1   18.   The computer-readable storage medium of claim 10, wherein

2   computing the deviation for the given segment involves using a model-based

3   technique for computing the deviation.

1   19.   An apparatus for controlling rippling caused by optical proximity

2   correction during an optical lithography process used in manufacturing an

3   integrated circuit, comprising:

4   a selection mechanism that is configured to,

5   select an evaluation point for a given segment that is part of

6   an edge in a layout of the integrated circuit, and to

7   select at least one supplemental evaluation point for the

8   given segment;

9   a deviation computing mechanism that is configured to,

10   compute a deviation from a target location for the given

11   segment at the evaluation point, and to

12   compute a supplemental deviation for the given segment at

13   the at least one supplemental evaluation point;

14   a bias adjustment mechanism that is configured to adjust a bias for the

15   given segment, if necessary, based upon the deviation at the evaluation point; and

16   a ripple control mechanism that is configured to,

17   calculate a ripple for the given segment based upon the

18   deviation at the evaluation point and the supplemental deviation,

19   and to

20   perform a ripple control operation if the ripple for the given

21   segment exceeds a threshold value.

1   20.   The apparatus of claim 19, wherein for each segment that is part of

2   the layout of the integrated circuit the bias adjustment mechanism is configured to

3   adjust the bias, if necessary, and the ripple control mechanism is configured to

4   perform the ripple control operation, if necessary.

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1   21.   The apparatus of claim 19, further comprising a dissection

2   mechanism that is configured to:

3   receive a specification of the layout; and to

4   dissect edges in the layout into segments for optical proximity correction

5   purposes.

1   22.   The apparatus of claim 19, wherein while performing the ripple

2   control operation, the ripple control mechanism is configured to:

3   select additional dissection points for the edge that cause the given

4   segment to be divided into multiple segments;

5   select additional evaluation points for the multiple segments;

6   select additional supplemental evaluation points for the multiple segments;

7   adjust the bias, if necessary, for each of the multiple segments; and to

8   perform the ripple control operation, if necessary, for each of the multiple

9   segments.

1   23.   The apparatus of claim 22, wherein selecting additional evaluation

2   points involves using supplemental evaluation points as the additional evaluation

3   points.

1   24.   The apparatus of claim 19, wherein while performing the ripple

2   control operation, the ripple control mechanism is configured to:

3   change the location of dissection points for the edge to cause the edge to

4   be divided into a different set of segments;

5   adjust the bias, if necessary, for each segment in the different set of

6   segments; and to

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7   perform the ripple control operation, if necessary, for each segment in the

8   different set of segments.

1   25.   The apparatus of claim 24, wherein changing the location of the

2   dissection points involves swapping dissection points and evaluation points for

3   the edge.

1   26.   The apparatus of claim 19, wherein while performing the ripple

2   control operation, the ripple control mechanism is configured to control the bias

3   for the given segment so that the ripple for the given segment does not exceed the

4   threshold value, wherein as a consequence of controlling the bias a critical

5   dimension for the given segment may not meet specification.

1   27.   The apparatus of claim 19, wherein the deviation computing

2   mechanism is configured to compute the deviation for the given segment using a

3   model-based technique.

1   28.   A mask to be used in an optical lithography process for

2   manufacturing an integrated circuit, wherein the mask is created through a process

3   that controls rippling caused by optical proximity correction, the process

4   comprising:

5   selecting an evaluation point for a given segment that is part of an edge in

6   a layout of the integrated circuit;

7   selecting at least one supplemental evaluation point for the given segment;

8   computing a deviation from a target location for the given segment at the

9   evaluation point;

10   computing a supplemental deviation for the given segment at the at least

11   one supplemental evaluation point;

12   adjusting a bias for the given segment, if necessary, based upon the

13   deviation at the evaluation point;

14   calculating a ripple for the given segment based upon the deviation at the

15   evaluation point and the supplemental deviation;

16   if the ripple for the given segment exceeds a threshold value, performing a

17   ripple control operation.

1   29.   An integrated circuit created through a process that controls

2   rippling caused by optical proximity correction during an optical lithography

3   process used in manufacturing the integrated circuit, the process comprising:

4   selecting an evaluation point for a given segment that is part of an edge in

5   a layout of the integrated circuit;

6   selecting at least one supplemental evaluation point for the given segment;

7   computing a deviation from a target location for the given segment at the

8   evaluation point;

9   computing a supplemental deviation for the given segment at the at least

10   one supplemental evaluation point;

11   adjusting a bias for the given segment, if necessary, based upon the

12   deviation at the evaluation point;

13   calculating a ripple for the given segment based upon the deviation at the

14   evaluation point and the supplemental deviation;

15   if the ripple for the given segment exceeds a threshold value, performing a

16   ripple control operation.

1   30.   A means for controlling rippling caused by optical proximity

2   correction during an optical lithography process used in manufacturing an

3   integrated circuit, comprising:

4   a selection means for,

5   selecting an evaluation point for a given segment that is

6   part of an edge in a layout of the integrated circuit, and for

7   selecting at least one supplemental evaluation point for the

8   given segment;

9   a deviation computing means for,

10   computing a deviation from a target location for the given

11   segment at the evaluation point, and for

12   computing a supplemental deviation for the given segment

13   at the at least one supplemental evaluation point;

14   a bias adjustment means for adjusting a bias for the given segment, if

15   necessary, based upon the deviation at the evaluation point; and

16   a ripple control means for,

17   calculating a ripple for the given segment based upon the

18   deviation at the evaluation point and the supplemental deviation,

19   and for

20   performing a ripple control operation if the ripple for the

21   given segment exceeds a threshold value.

1   31.   A method for controlling rippling caused by optical proximity

2   correction during an optical lithography process used in manufacturing an

3   integrated circuit, comprising:

4   selecting a first evaluation point for a given segment that is part of an edge

5   in a layout of the integrated circuit;

6   selecting a second evaluation point for the given segment;

7   computing a first deviation from a target location for the given segment at

8 the first evaluation point;

9   computing a second deviation for the given segment at the second

10 evaluation point; and

11   adjusting a bias for the given segment, if necessary, based upon multiple

12 deviations at multiple evaluation points, including the first deviation at the first

13 evaluation point and the second deviation at the second evaluation point.

1   32.   The method of claim 31, wherein the second evaluation point is a

2 supplemental evaluation point.

1   33.   The method of claim 31, wherein both the first evaluation point

2 and the second evaluation point are located on the given segment.

1   34.   The method of claim 31, wherein the first evaluation point is

2 located on the given segment and the second evaluation point is located on an

3 adjacent segment.

1   35.   The method of claim 31, further comprising adjusting the bias, if

2 necessary, for each segment that is part of the layout of the integrated circuit.

1   36.   The method of claim 31, further comprising:

2   selecting a third evaluation point for the given segment; and

3   computing a third deviation for the given segment at the third evaluation

4 point;

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1   wherein adjusting the bias for the given segment involves considering the

2   third deviation at the third evaluation point.

1   37.   The method of claim 31, wherein computing the first deviation

2   involves using a model-based technique for computing the first deviation.

1   38.   A computer-readable storage medium storing instructions that

2   when executed by a computer cause the computer to perform a method for

3   controlling rippling caused by optical proximity correction during an optical

4   lithography process used in manufacturing an integrated circuit, the method

5   comprising:

6   selecting a first evaluation point for a given segment that is part of an edge

7   in a layout of the integrated circuit;

8   selecting a second evaluation point for the given segment;

9   computing a first deviation from a target location for the given segment at

10 the first evaluation point;

11   computing a second deviation for the given segment at the second

12 evaluation point; and

13   adjusting a bias for the given segment, if necessary, based upon multiple

14 deviations at multiple evaluation points, including the first deviation at the first

15 evaluation point and the second deviation at the second evaluation point.

1   39.   The computer-readable storage medium of claim 38, wherein the

2   second evaluation point is a supplemental evaluation point.

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1   40.   The computer-readable storage medium of claim 38, wherein both

2   the first evaluation point and the second evaluation point are located on the given

3   segment.

1   41.   The computer-readable storage medium of claim 38, wherein the

2   first evaluation point is located on the given segment and the second evaluation

3   point is located on an adjacent segment.

1   42.   The computer-readable storage medium of claim 38, wherein the

2   method further comprises adjusting the bias, if necessary, for each segment that is

3   part of the layout of the integrated circuit.

1   43.   The computer-readable storage medium of claim 38, wherein the

2   method further comprises:

3   selecting a third evaluation point for the given segment; and

4   computing a third deviation for the given segment at the third evaluation

5   point;

6   wherein adjusting the bias for the given segment involves considering the

7   third deviation at the third evaluation point.

1   44.   The computer-readable storage medium of claim 38, wherein

2   computing the first deviation involves using a model-based technique for

3   computing the first deviation.

1   45.   An apparatus for controlling rippling caused by optical proximity

2   correction during an optical lithography process used in manufacturing an

3   integrated circuit, comprising:

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4   a selection mechanism that is configured to,

5   select a first evaluation point for a given segment that is

6   part of an edge in a layout of the integrated circuit, and to

7   select a second evaluation point for the given segment;

8   a deviation computing mechanism that is configured to,

9   compute a first deviation from a target location for the

10   given segment at the first evaluation point, and to

11   compute a second deviation for the given segment at the

12   second evaluation point; and

13   a bias adjustment mechanism that is configured to adjust a bias for the

14   given segment, if necessary, based upon multiple deviations at multiple evaluation

15   points, including the first deviation at the first evaluation point and the second

16   deviation at the second evaluation point.

1   46.   The apparatus of claim 45, wherein the second evaluation point is a

2   supplemental evaluation point.

1   47.   The apparatus of claim 45, wherein both the first evaluation point

2   and the second evaluation point are located on the given segment.

1   48.   The apparatus of claim 45, wherein the first evaluation point is

2   located on the given segment and the second evaluation point is located on an

3   adjacent segment.

1   49.   The apparatus of claim 45, wherein the bias adjustment mechanism

2   is configured to adjust the bias, if necessary, for each segment that is part of the

3   layout of the integrated circuit.

1   50.   The apparatus of claim 45,

2   wherein the selection mechanism is additionally configured to select a

3   third evaluation point for the given segment; and

4   wherein the deviation computing mechanism is additionally configured to

5   compute a third deviation for the given segment at the third evaluation point;

6   wherein the bias adjustment mechanism is configured to consider the third

7   deviation at the third evaluation point in adjusting the bias for the given segment

8   involves.

1   51.   The apparatus of claim 45, wherein the deviation computing

2   mechanism is configured to compute use a model-based technique in computing

3   the first deviation.

1   52.   A mask to be used in an optical lithography process for

2   manufacturing an integrated circuit, wherein the mask is created through a process

3   that controls rippling caused by optical proximity correction, the process

4   comprising:

5   selecting a first evaluation point for a given segment that is part of an edge

6   in a layout of the integrated circuit;

7   selecting a second evaluation point for the given segment;

8   computing a first deviation from a target location for the given segment at

9   the first evaluation point;

10   computing a second deviation for the given segment at the second

11   evaluation point; and

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12   adjusting a bias for the given segment, if necessary, based upon multiple

13 deviations at multiple evaluation points, including the first deviation at the first

14 evaluation point and the second deviation at the second evaluation point.

1   53.   An integrated circuit created through a process that controls

2   rippling caused by optical proximity correction during an optical lithography

3   process used in manufacturing the integrated circuit, the process comprising:

4   selecting a first evaluation point for a given segment that is part of an edge

5   in a layout of the integrated circuit;

6   selecting a second evaluation point for the given segment;

7   computing a first deviation from a target location for the given segment at

8   the first evaluation point;

9   computing a second deviation for the given segment at the second

10 evaluation point; and

11   adjusting a bias for the given segment, if necessary, based upon multiple

12 deviations at multiple evaluation points, including the first deviation at the first

13 evaluation point and the second deviation at the second evaluation point.

1   54.   A means for controlling rippling caused by optical proximity

2   correction during an optical lithography process used in manufacturing an

3   integrated circuit, comprising:

4   a selection means for,

5   selecting a first evaluation point for a given segment that is

6   part of an edge in a layout of the integrated circuit, and for

7   selecting a second evaluation point for the given segment;

8   a deviation computing means for,

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9   computing a first deviation from a target location for the

10   given segment at the first evaluation point, and for

11   computing a second deviation for the given segment at the

12   second evaluation point; and

13   a bias adjustment means for adjusting a bias for the given segment, if

14   necessary, based upon multiple deviations at multiple evaluation points, including

15   the first deviation at the first evaluation point and the second deviation at the

16   second evaluation point.

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